UNIVERSITY OF SRI JAYEWARDANEPURA
FACULTY OF APPLIED SCIENCES

B. Sc. General/Special Degree Third Year Second Semester Course Unit Examination

December, 2019

DEPARTMENT OF PHYSICS

PHY 310 1.0 / PHY 329 1.0 / PHY 373 1.0 – Space Physics - I

Time : One hour
No of Questions : 03
No of Pages : 02
Total marks : 60

Answer all questions

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01. (***a***) Define the "Mean Free Path" of the gases in the Earth's atmosphere?

(***b***) In the Earth's atmosphere, the mean free path of the gas molecules, d (in meters) is given by,

$$d(h) = a\ h^6 + b$$

Where h is height (in meters), a and b are unknown constants.

The mean free path of the gas molecules at the mean sea level is $6.0 \times 10^{-8} m$ and the mean free path of the gas molecules at the $100\ km$ height is $0.1 m$.

(i) Determine the values of a and b of the above equation.

(ii) Determine the height from the mean sea level where the mean free path of the gas molecules becomes $100.0 m$.

(20 Marks)

02. (***a***) Define the term "**solar flare**".

(***b***) A sudden large increase in the number of Sunspots is observed to have an approximate cycle of several years.
What is,

(i) Rudolf Wolf's idea,

(ii) George Ellery Hale's idea

about the above solar cycles ?

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(***c***) The last five solar cycles (Sunspots Maxima) are displayed in the following table, based on the NASA observation charts.

Solar Cycle	Year
20	1968
21	1979
22	1989
23	2000
24	2014

(i) According to the Rudolf Wolf's idea, when will be the next sunspots maxima (25^{th} solar cycle) ?

(ii) According to the George Ellery Hale's idea, when will be the next sunspots maxima (25th solar cycle) ?

(20 Marks)

<u>03.</u> (***a***) Sketch the profile of the day-time ionosphere of the Earth, and indicate heights of "**D**", "**E**", "$\mathbf{F_1}$" and "$\mathbf{F_2}$" regions.

(***b***) If vertically incident radio wave of frequency f is reflected from the ionosphere, **<u>you are given</u>** the free electron density, N_e as,

$$N_e = \frac{4\ \pi^2 \varepsilon_o m_e}{e^2}\ f^2 .$$

Where, ε_o is permeability of free space, m_e is mass of an electron and e is charge of an electron.

Show that, $f^2 \approx 80\ N_e$.

(***c***) At a certain instance, the maximum free electron density of the ionosphere is 10^{12} electrons/m^3.

Determine the maximum penetrating frequency, f_m of the ionosphere at this instance.

Hence, **show that** the **UHF** (~300 MHz) and the **VHF** (~30 MHz) signals can be used for satellite transmission.

You are given, $\varepsilon_o = 8.8\times10^{-12}\ F/m$,

$m_e = 9.1\times10^{-31}\ kg$ and

$e = 1.6\times10^{-19}\ C$.

(20 Marks)

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